If these condensing turbines are provided with automatic bleeding devices to take steam for the heating system at 5 pounds pressure above atmosphere, it will be possible with 150 pounds steam pressure and 28 inches vacuum to extract a maximum of 15,000 pounds of steam per hour from the 750 K.W. turbine at half load, with a total flow of steam at the throttle of about 16,000 pounds. At full load the maximum extraction would be

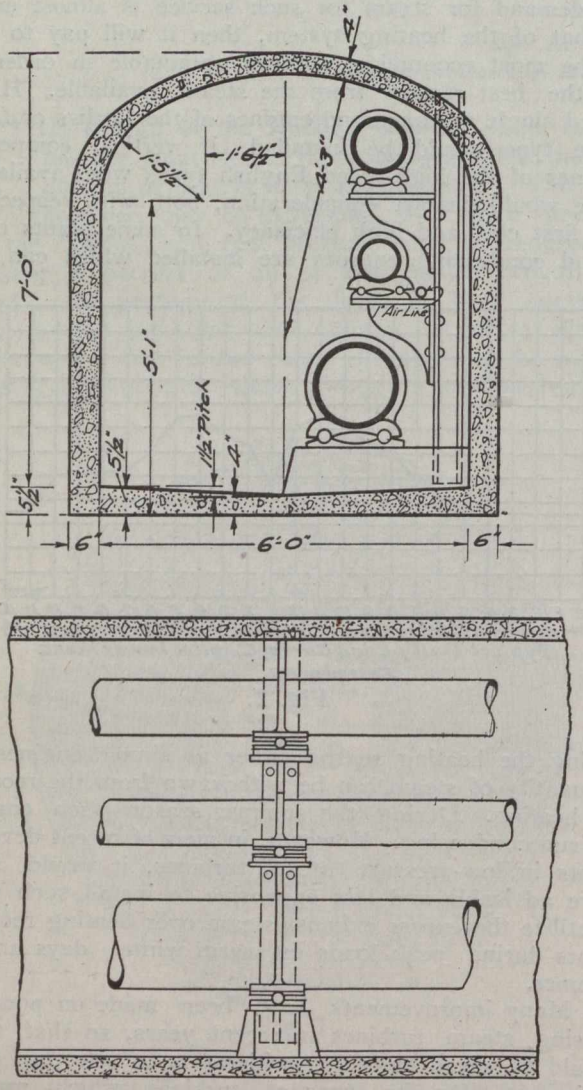

Fig. 3.—University of Wisconsin—Standard Heating Tunnel.

about 28,000 pounds with a total flow at the throttle of about 29,000 pounds. The 1,000 K.W. condensing turbine under similar conditions will have a maximum bleeding capacity of about 19,000 pounds per hour at half load, with a total flow at the throttle of 20,000 pounds. At full load it is possible to withdraw 37,000 pounds per hour with a total flow at the throttle of 38,000 pounds.

This data, from a leading manufacturer, is presented to show the results that can be expected from such type of turbine. The advantage of the bleeder type lies in the fact that it may be operated condensing entirely during the summer months, and thus high efficiency may be maintained.

There has been considerable information published relative to the bleeder type of turbine. Further data on this question can be found in a paper by A. H. Kreusi on "Heating in Connection with Steam Turbines," read before the National District Heating Association at Detroit in June, 1912, and also a paper by E. D. Dreyfus on "Notes on an Economic Survey of Combined Central Heating and Electric Plants," presented at the same meeting. The latter paper presents some interesting graphical diagrams showing the results obtained with Westinghouse bleeder turbines.

In many plants it has been found more desirable to install separate condensing units than to attempt to adapt one type of engines to all conditions of operation. These condensing units can be used on the peak loads. Occasionally storage batteries are also provided to improve the load factor by helping out on peaks.

The boiler feed-pumps in a large central station should be of the turbine driven type, although in small plants duplex steam pumps with automatic governors are generally used.

The circulating pumps in hot water heating systems are now generally of the centrifugal type, driven by non-condensing steam turbines, which exhaust into the heaters. Sometimes these pumps are motor driven, though this is not common.

Pipe Lines and Conduits.—The most important portion of the district heating equipment is the underground transmission system. For economy in operation this should be made of the very best possible construction, and should be easily accessible for repairs at all times. On the other hand, too high first cost results in high fixed charges on the service rendered. The conduits, pipe lines and auxiliary service must be designed so as to provide the most economical system in operation that can be installed with the capital available.

The franchise or permit of the heating company allows it to make use of the streets and alleys of the city. The plan of the city will show at a glance whether it is possible to use the alleys for conduits. The choice between streets and alleys depends on two things: (1) The relative cost of street and alley construction; and (2) the location of the buildings to be served relative to the streets or alleys. It has been authoritatively stated that, other things being equal, alley construction will cost 15 to 30 per cent. more for labor than street work, owing to the difficulty of working in the narrow space. An important factor affecting street construction costs is the amount of paving that has to be torn up and relaid. The heating companies are obliged in most cities to bring their service pipes to the curb line in a street and to the property line in an alley. This item of expense should not be overlooked in choosing between street and alley construction, for on wide streets the extra cost for service lines will more than eat up the saving in labor effected by street construction.

The form of conduit to be employed in any given installation will be dependent on local considerations. When a large main or a number of pipes, such as high-pressure steam, low-pressure steam, condensation return or other piping must be laid for some distance in one direction before branching off for distribution, it is probable that a reinforced concrete tunnel would be most satisfactory. However, it will generally be found that the greater portion of all heating systems are laid in some form of underground conduit.

Piping tunnels allow joints to be watched and repairs and alterations to be made with comparative ease. Their first cost is high, but they never need opening up f properly built. Fig. 3 shows a section of standard piping tunnel used at the University of Wisconsin. The pipes are carried by saddles with ball bearings resting on brackets fastened to vertical I-beams, which are imbedded in the concrete. Any section of pipe can be readily removed with this construction. Anchors and expansion joints are provided at proper intervals. Tunnels need